

# इंटरनेट

# मानक

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“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 10236-17 (1988): Procedure for Basic Climatic and Durability Tests for Optical Instruments, Part 17: Acceleration (Steady-State) Test [PGD 22: Educational Instruments and Equipment]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”



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## Indian Standard

PROCEDURE FOR BASIC CLIMATIC AND  
DURABILITY TESTS FOR OPTICAL INSTRUMENTS

## PART 17 ACCELERATION ( STEADY-STATE ) TEST

**1. Scope** — Covers the procedure for conducting acceleration ( steady-state ) test for optical instruments.

**2. Terminology** — For the purpose of this standard the definitions given in IS : 10236 ( Part 1 ). 'Procedure for basic climatic and durability tests for optical instruments: Part 1 General ( *under preparation* )', shall apply.

**3. Object** — To determine the structural suitability and the satisfactory performance of optical instruments when subjected to force produced by steady acceleration environments ( other than gravity ) such as that occurring in aircrafts, helicopters and manned aerospace vehicles.

**4. Initial Measurements** — The instrument shall be visually examined, and optically, electrically and mechanically checked as required by the relevant instrument specification.

**5. Test Equipment** — Normally a centrifuge shall be used for this test. In some cases, a special test equipment may be required ( *see 5.2* ) which shall be specified in the relevant instrument specification.

**5.1** The centrifuge shall be capable of being brought up to a speed of rotation sufficient to develop a steady acceleration corresponding to any severity given in 6.1 and shall also be capable of maintaining this value for the specified duration.

**5.2** The centrifuge shall be such that the acceleration is directed towards the centre of the rotating system. In certain special cases, however the specimen may be sensitive to gyroscopic couples and it may only be possible to perform the test by using a machine capable of applying linear acceleration. In such cases, the relevant instrument specification shall specify a suitable test equipment for performing this test.

**Note** — When a machine capable of applying linear acceleration is used, the duration of the test shall be much less than that required in case of a centrifuge.

**5.3 Tangential Acceleration** — While increasing the rotational speed of the centrifuge from zero to the value necessary to achieve the specified acceleration or while decreasing back to zero, the machine should be so controlled that the specimen is not subjected to a value of tangential acceleration greater than 10 percent of the specified steady acceleration.

**5.4 Acceleration Gradient** — The dimensions of the centrifuge relative to the instrument under test shall be such that no part of the instrument other than flying leads shall be subjected to a value of acceleration outside the tolerance limits given in 5.6.

**5.5 Steady acceleration or  $g$ -levels on different parts of the instrument may be calculated on the basis of the relation given below:**

$$g\text{-level} = krN^2$$

where

$k = 1.12 \times 10^{-3}$  for metric calculations,

$r$  = radial distance from the centre of rotation to the part of mounted instrument on centrifuge arm in metres, and

$N$  = centrifuge arm revolutions per minute.

**5.6 Acceleration Tolerance** — If the linear dimensions of the instrument are less than 10 cm, the acceleration on all parts of the instrument ( excluding flying leads ) shall be within  $\pm 10$  percent of the specified steady acceleration.

In other cases, the acceleration on all parts of the instrument ( excluding flying leads ) shall be within the limits  $-10$  percent to  $+30$  percent of the specified steady acceleration.

**Note** — In some cases, for example, large instruments, it may be difficult to comply with these requirements. In such cases, it may be permissible by mutual agreement between the manufacturer and the customers to move the instrument outwards along the radius of the centrifuge until the part of the instrument nearest to the centre of the centrifuge experiences an acceleration within the specified tolerance limits.

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**5.7** The centrifuge shall have provision to supply electric power to the instrument under test and also to operate under the specified conditions.

## 6. Test Severities

**6.1** The severity indicated by acceleration shall be as specified in the relevant instrument specification. The value may be selected from those given in Tables 1 and 2 depending upon the procedure of test.

**6.1.1** The  $g$ -level to be applied to the instrument is dependent on two factors: (a) the direction of forward acceleration level  $A$  of the vehicle, and (b) the orientation of the instrument within the vehicle, where  $A$  is the highest possible known or unknown forward acceleration of a vehicle in which the instrument is to be mounted.  $A$  shall never be less than  $g$ -level.

**6.1.2** The selection of test levels shall be from Table 1 for Procedure 1 and from Table 2 for Procedure 2. The instructions for such selection are as follows:

<i>Forward Acceleration of Vehicle</i>	<i>Orientation of Instrument Under Test in Vehicle</i>	<i>Test Level</i>
Known	Known	Substitute known acceleration $A$ in forward acceleration column of appropriate vehicle category and use given multiplying factors to obtain test levels for testing in the six indicated directions. For helicopters, the test levels given in relevant table shall apply.
Unknown	Known	Select most probable value $A$ from those given in forward acceleration column of appropriate vehicle category and use given multiplying factors to obtain test levels for testing in the six indicated directions. For helicopters, the test levels given in relevant table shall apply.
Known	Unknown	Substitute known acceleration $A$ in forward acceleration column of appropriate vehicle category and use largest given multiplying factor to obtain a highest test level. Use this level for testing in each of the six indicated directions. For helicopters, the highest test level given in the relevant table shall apply for testing in all the six directions.
Unknown	Unknown	Select most probable value $A$ from those given in forward acceleration column of appropriate vehicle category and use largest given multiplying factor to obtain a highest test level. Use this level for testing in each of the six indicated directions. For helicopters, the highest test level given in the relevant table shall apply for testing in all the six directions.

## 7. Test Procedure

### 7.1 Mounting

**7.1.1** Direction of forward acceleration is always considered to be the direction of the vehicle acceleration and instrument shall be oriented accordingly using the normal mounting means. If isolators are used in its normal mounting of the instrument, these isolators shall also be used for mounting the instrument, unless otherwise specified by the relevant instrument specification. Any additional stays or straps shall be avoided, wherever possible.

**7.1.2** The instrument under test shall be mounted on the acceleration machine directly or by means of suitable fixtures. These fixtures shall be such as to enable the instrument to be subjected to acceleration forces in the direction required by the relevant instrument specification. Any external connections necessary for measuring purposes shall add a minimum restraint and mass.

**Note**—For reasons of safety, care shall be taken to prevent instrument under test from being thrown off, if the mounting attachments are broken, but any safety devices used shall not introduce additional constraint during the test.

**7.1.3** If cables, pipes, etc, are required to be connected to the instrument during test, as specified in relevant instrument specification, these shall be so arranged as to add similar restraint and mass as in the normal installation.

**7.1.4** When a centrifuge is used to attain the required acceleration level, the instrument under test shall be oriented as follows:

- Fore* — Front or forward end of instrument under test shall face towards the centre of centrifuge;
- Aft* — Reverse instrument 180 degrees from the 'Fore' position;
- Up* — Top of the instrument shall face towards the centre of the centrifuge;
- Down* — Reverse instrument 180 degrees from the 'Up' position; and
- Lateral* — Each side ( right or left ), in turn, shall face towards the centre of centrifuge.

**7.2** If the attitude of the instrument is not fixed or not known with regard to the vehicle, the relevant instrument specification shall prescribe one level for Procedure 1 and other level for Procedure 2 that may be applied along each of the major axes and senses of the instrument.

**7.3** The instrument shall be subjected to both the structural test ( Procedure 1 ) and the operational test ( Procedure 2 ), unless otherwise specified in the relevant instrument specification. The *g*-levels specified under these procedures shall satisfy the conditions given below:

- a) *Structural or ultimate level* — A higher level of acceleration to check resistance to structural deformation.
- b) *Operational or proof level* — Normally the specimen would be required to function at this level without degradation in performance within the stated specification limit.

**7.4** In addition, if required by the relevant instrument specification, a still higher acceleration level may be specified as a means of checking the ability of a specimen to remain firmly attached to its mounting ( though it may be permanently damaged or deranged ) and not to break loose during emergency conditions, for instance, in a manner liable to create a hazard to personnel, either directly or by interference with emergency exits, etc.

#### **7.5 Procedure 1 — Structural test.**

**7.5.1** The instrument under test shall be mounted on the centrifuge as given in 7.1.

**7.5.2** The instrument shall be subjected to the acceleration corresponding to the vehicle category given in Table 1 ( *see also* 6.1.2, 7.2 and Fig. 1 ) by rotating the centrifuge at a speed necessary to produce the required level.

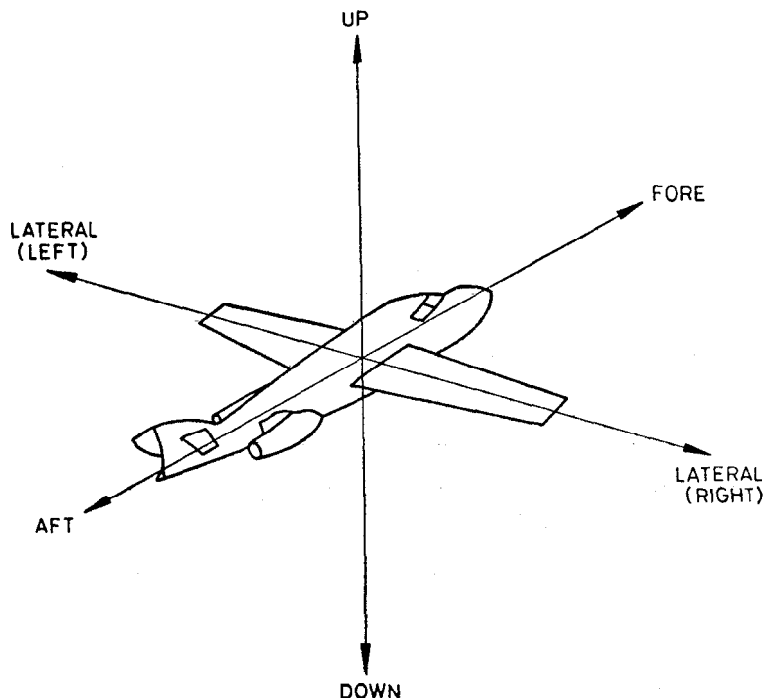


FIG. 1 DIRECTION OF VEHICLE ACCELERATION

**7.5.3** Unless otherwise stated in the relevant instrument specification, the *g*-level determined for the test shall be applied along both the senses of three mutually perpendicular axes, in turn.

**7.5.4** The test time duration in each direction shall be 1 minute after attaining the centrifuge stabilization. However, the test time may be decreased up to 10 seconds or increased up to 2 minutes, if so required by the relevant instrument specification.

**Note**—The test time duration applies to centrifuge only. Other test equipment may require a different duration which shall be specified in the relevant instrument specification.

**7.5.5** After the test, the instrument shall be removed from the centrifuge. It shall be visually examined and shall be electrically and mechanically checked in accordance with the relevant instrument specification.

## **7.6 Procedure 2 — Operational test.**

**7.6.1** The instrument under test shall be mounted on the centrifuge as given in 7.1.

**7.6.2** The instrument shall be subjected to the acceleration corresponding to the vehicle category given in Table 2 ( *see also* 6.1.2, 7.2 and Fig. 1 ) by rotating the centrifuge at a speed necessary to produce the required level.

**7.6.3** Unless otherwise stated in the relevant instrument specification, the *g*-level determined for the test shall be applied along both the senses of three mutually perpendicular axes, in turn.

**7.6.4** The test time duration in each direction shall be 1 minute after attaining centrifuge stabilization. However, the test time may be decreased up to 10 seconds or increased up to 2 minutes, if so required by the relevant instrument specification.

**Note**—The test time duration applies to centrifuge only. Other test equipment may require a different duration which shall be specified in the relevant instrument specification.

**7.6.5** The test specimen shall be operated during the test, unless otherwise specified by the relevant instrument specification.

**7.6.6** After the test instrument is removed from the centrifuge, it shall be visually examined, and electrically and mechanically checked in accordance with relevant instrument specification.

## **8. Details to be Given in Instrument Specification**

**8.1** The relevant instrument specification shall state the following for carrying out this test:

- a) Suitable test equipment and duration of test, if the test can not be done on a centrifuge.
- b) Initial observations/measurements.
- c) Vehicle or vehicles where the instrument is used.
- d) Highest possible forward acceleration level of the vehicle, if known.
- e) Whether the orientation of the instrument within the vehicle is fixed and known.
- f) The orientation of the instrument and directions during conditioning.
- g) Whether isolators are to be used for mounting ( if relevant ).
- h) Procedure to be adopted, if both procedures are not required.
- j) Test duration, if other than 1 minute.
- k) Higher acceleration level, if necessary, to check that the instrument does not break loose during emergency conditions.
- m) Observations/measurements after each test.
- n) Any deviation from the normal procedure.

TABLE 1 *g*-LEVELS FOR STRUCTURAL TEST ( PROCEDURE 1 )

( Clause 7.5.2 )

Vehicles Category	Forward Acceleration ( See Note ) <i>A</i>	Test Level				
		Direction of Vehicle Acceleration ( see Fig. 1 )				
		Fore	Aft	Up	Down	Lateral ( two directions )
Aircrafts	2.0	$1.5 \times A$	$4.5 \times A$	$6.75 \times A$	$2.25 \times A$	$3.0 \times A$
Helicopters	See Note	4.0	4.0	10.5	4.5	6.0
Manned aerospace vehicles	6.0 to 12.0	$1.5 \times A$	$0.5 \times A$	$2.25 \times A$	$0.75 \times A$	$1.0 \times A$

**Note** — Levels given in column under forward acceleration shall be used when forward acceleration is unknown. When the forward acceleration of the vehicle is known, that level shall be used for *A*. For helicopters, forward acceleration is unrelated to acceleration in the other directions.

TABLE 2 *g*-LEVELS FOR OPERATIONAL TEST ( PROCEDURE 2 )

( Clause 7.6.2 )

Vehicles Category	Forward Acceleration ( See Note ) <i>A</i>	Test Level				
		Direction of Vehicle Acceleration ( see Fig. 1 )				
		Fore	Aft	Up	Down	Lateral ( two directions )
Aircrafts	2.0	$1.0 \times A$	$3.0 \times A$	$4.5 \times A$	$1.5 \times A$	$2.0 \times A$
Helicopters	See Note	2.0	2.0	7.0	3.0	4.0
Manned aerospace vehicles	6.0 to 12.0	$1.0 \times A$	$0.33 \times A$	$1.5 \times A$	$0.5 \times A$	$0.66 \times A$

**Note** — Levels given in column under forward acceleration shall be used when forward acceleration is unknown. When the forward acceleration of the vehicle is known, that level shall be used for *A*. For helicopters, forward acceleration is unrelated to acceleration in the other directions.

## EXPLANATORY NOTE

This Standard is one of a series of Indian Standards relating to procedure for basic climatic and durability tests for optical instruments. Fast development in the field of instruments had brought a significant change in their basic content and design. It has been felt over a years that IS : 2352-1963 'Procedure for basic climatic and durability tests for optical instruments' does not cater for the present day needs of the instruments and it is also not in line with the recent trends in climatic and environmental testing procedures to be adopted for meeting their quality and reliability. It has, therefore, become necessary to have uniform and more rational testing procedures as far as possible. This series of standards on climatic and durability tests ( IS : 10236 ) has been prepared with this objective. The other standards in this series are as follows:

IS : 10236 ( Part 1 ) Procedure for basic climatic and durability tests for optical instruments:  
Part 1 General

IS : 10236 ( Part 2 )-1982 Dry heat test

IS : 10236 ( Part 3 )-1982 Cold test

IS : 10236 ( Part 4 )-1982 Damp heat test

IS : 10236 ( Part 5 )-1982 Damp heat ( cyclic ) test

IS : 10236 ( Part 6 )-1982 Salt mist test

IS : 10236 ( Part 7 )-1983 Mould growth test

## **IS : 10236 ( Part 17 ) - 1988**

IS : 10236 ( Part 8 )-1983 Thermal shock ( rapid change of temperature ) test

IS : 10236 ( Part 9 )-1983 Low air pressure ( altitude ) test

IS : 10236 ( Part 10 )-1985 Bump test

IS : 10236 ( Part 11 )-1985 Vibration test

IS : 10236 ( Part 12 )-1985 Shock test

IS : 10236 ( Part 13 )-1986 Dust test

IS : 10236 ( Part 14 )-1986 Driving rain test

IS : 10236 ( Part 15 )-1986 Drop test

IS : 10236 ( Part 16 )-1988 Solar radiation test

IS : 10236 ( Part 18 )            Sealing test

It is proposed to withdraw IS : 2352-1963 as soon as the test mentioned in the new series of IS : 10236 are published.

While preparing this standard, considerable assistance has been derived from the details supplied by the leading inspection authorities and manufacturers of this product as well as from draft DIN 58390 Teil 16 'Uniform acceleration, centrifugal, under dry heat or cold', issued by the Deutsches Institut für Normung ( DIN ).